

REMARKS

Claims 1-14 are pending. No new matter has been added by way of the present amendment. For instance, a minor typographical error has been corrected in the specification. Also, new claim 14 is supported by originally filed claim 4. The difference between original claim 4 and newly added claim 14 is that claim 14 requires that in formula (2a), R¹ and R² taken together form an aliphatic hydrocarbon ring with the carbon atom to which they are attached. Thus, claim 14 is narrower than originally filed claim 4. Accordingly, no new matter has been added.

In view of the following remarks, Applicants respectfully request that the Examiner withdraw all rejections and allow the currently pending claims.

Issues under 35 U.S.C. §103(a)

The Examiner has presented four separate rejections under 35 U.S.C. § 103(a). Applicants will deal with these rejections in two groups below. The first group of rejections will deal with obviousness rejections based upon Nishi et al., U.S. Publication 2002/0132182. The second group of rejections will deal with obviousness rejections based upon Hasegawa et al., U.S. Publication 2004/0061824A1.

1. Obviousness Rejections Based Upon Nishi et al., U.S. 2002/0132182

The Examiner has rejected claims 1, 2, 4, and 5 and 7-10 under the 35 U.S.C. §103(a) as being obvious over Nishi et al., U.S. Publication 2002/1032182A1 in view of Hatakeyama et al., JP 2001-278918.

The Examiner has also rejected claims 1, 2, 4 and 6-13 under 35 U.S.C. §103(a) as being obvious over Nishi et al., U.S. Publication 2002/1032182A1 in view of Takeda et al., U.S. Publication 2002/0168581A1.

Applicants respectfully traverse each of the above rejections.

The Present Invention and its Advantages

As disclosed in the present specification and as known in the art, the two-layer resist method is advantageous in forming a high-aspect ratio pattern on a stepped substrate. Also, in order for a two-layer resist film be developable with a common alkaline developer, high molecular weight silicone compounds having hydrophilic groups such as hydroxyl and carboxyl groups should be used.

Drawbacks of the silicon-containing resist compositions include poor line edge roughness and the generation of scum on substrates. Silicon-containing groups, especially alkyl-substituted silyl groups are extremely hydrophobic so that they interfere with development with alkaline water and incur swelling. As a result, line edge roughness is exaggerated, and residues following dissolution form scum on the substrate or resist pattern.

It is reported in Ushirogouchi et al., SPIE vol. 3999 (2000), p. 1147 (of record) that sensitivity and resolution are improved by imparting hydrophilic properties to not only adhesive groups, but also to acid labile groups. Although this deals with an ArF single layer resist, the improvement in hydrophilicity will be effective for reducing the swelling of an ArF single layer resist using an aliphatic ring which is more water repellent and liable to swell in an aqueous

alkaline developer. In the event of silicon-containing groups which are more water repellent than the aliphatic ring, it is necessary to enhance hydrophilicity.

The present invention has been accomplished in order to solve the above problems. Therefore, an object of the invention is to provide a polymer and a chemically amplified positive resist composition comprising the same, which exhibit a high sensitivity and a high resolution because of a high dissolution contrast. Further, the present invention achieves the advantages of a lack of swelling during development, minimized line edge roughness and a lack of generation of residue, despite an increased silicon content. The present invention is especially suitable as a material for use in the two-layer resist method adapted to form a high-aspect ratio pattern.

Specifically, the present invention relates to a polymer comprising recurring units bearing a hydrophilic acid labile group of any of the general formulae (1) and (3), and recurring units bearing a silicon-containing substituent group on any of the general formula (10) to (16). The present polymer has a high sensitivity and resolution, and undergoes no swelling during development, exhibits minimized line edge roughness and yields no residue, even when the silicon content is increased. The polymer is advantageously used in the two-layer resist method adapted to form a high-aspect ratio pattern.

The effect of the present invention is fully proved by the Examples of the present specification. For instance, as is shown in Table 2, the inventive resist compositions have a small line edge roughness.

Distinctions Between the Present Invention and the Cited Art

The primary reference utilized in the above two noted rejections is Nishi. Referring to Nishi, in particular page 28, paragraph 201, Polymer 2 appears to fall within the scope of the recurring units having a substituent group of general formula (1) and (2) according to the present invention. However, as admitted by the Examiner, the Nishi reference fails to suggest that such polymers would have recurring units containing silicon. Thus, the Examiner has utilized secondary references, for instance Hatakeyama or Takeda, to disclose specific polymers containing one or more silicon containing substituents. However, Applicants submit that there is no motivation to support such a modification; thus, there exists no *prima facie* case of obviousness.

For instance, although both Hatakeyama and Takeda disclose polymers with silicon containing substituents, and although these polymers are utilized in resist materials, the references do not provide specific motivation to combine the teachings as suggested by the Examiner. For instance, in order to make such a modification, one of skill in the art would have to select the specific Polymer 2 of Nishi, while ignoring all other disclosed polymers, and then, modify this specific polymer to include silicon containing substituents. The idea for such silicon containing substituents could be taken from either Hatakeyama or Takeda, however, both Hatakeyama and Takeda simply suggest specific silicon containing materials as being useful in chemically amplified positive type resist materials. These references do not specifically indicate that the simple addition of silicon containing substituents is the key factor in the success of these materials. Thus, there is no motivation to simply add silicon containing substituents to any polymer, for instance the specific Polymer 2 of Nishi, in order to obtain a new material.

Based upon the above, Applicants respectfully submit that there exists no *prima facie* case of obviousness. Accordingly, for this reason alone the Examiner's rejection is improper. Moreover, even if the Examiner has hypothetically established a *prima facie* case of obviousness, a point not conceded by Applicants, Applicants submit that the present invention achieves unexpectedly superior results as discussed above.

For instance, the present invention unexpectedly achieves superior properties with respect to resist compositions having small line edge roughness. None of the references cited by the Examiner suggests or disclose improvement in properties concerning small line edge roughness. Thus, even if Hatakeyama or Takeda were combined with Nishi, the unexpected properties according to the present invention, for instance the small line edge roughness, could not be expected. Thus, the present superior results, as illustrated in Table 2 of the present specification, are unexpected over the prior art and thus render any hypothetical *prima facie* case of obviousness moot.

Based upon the above, Applicants respectfully request that the Examiner withdraw all rejections based upon Nishi.

2. Rejections based upon Hasegawa et al., U.S. Publication 2004/0068124A1

The Examiner has rejected claims 1-5 and 7-13 under 35 U.S.C. §103(a) as being obvious over Hasegawa et al., U.S. Publication 2004/0068124A1 in view of Hatakeyama et al., JP 2001-278918.

Additionally, the Examiner has rejected claims 1-4 and 6-13 under U.S.C. §103(a) as being obvious over Hasegawa et al., U.S. Publication 2004/0068124 in view of Takeda.

Applicants respectfully traverse each of the above rejections.

Applicants submit the Hasegawa reference and the present invention were subject to an obligation of assignment to the same Assignee (Shin-Etsu Chemical Co., Ltd.) at the time of the present invention. Attached are copies of recorded Assignments for both applications. Thus, pursuant to 35 U.S.C. §103(c) this reference is disqualified as prior art under 35 U.S.C. §103(a) since the only effective date is the 35 U.S.C. §102(e) date of September 29, 2003.

Thus, the rejections based upon Hasegawa are improper and should be withdrawn.

In view of the above, Applicants respectfully submit the present claims define allowable subject matter. Accordingly, the Examiner is respectfully requested to withdraw all rejections and allow the currently pending claims.

If the Examiner has any questions or comments, please contact Craig A. McRobbie, Registration No. 42,874 at the offices of Birch, Stewart, Kolasch & Birch, LLP.

Application No.: 10/765,919


Docket No.: 0171-1058P

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to our Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under § 1.17; particularly, extension of time fees.

Dated:

MAR 30 2006

Respectfully submitted,

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Attachments: Copies of Assignments from 10/765,919, and
Hasegawa et al., U.S. Publication 2004/0068124A1.



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Patent Assignment Abstract of Title

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Inventors: Koji Hasegawa, Takeshi Kinsho, Takeru Watanabe

Title: Novel ester compounds, polymers, resist compositions and patterning process

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BRIEF: ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS).

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DOC DATE: 12/22/2003

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DOC DATE: 12/22/2003

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ATTORNEY DOCKET NO.
0171-1058P

ASSIGNMENT

Application No. NEW

Filed January 29, 2004

Insert Name(s) of Inventor(s) ➡ WHEREAS, Jun HATAKEYAMA, Takanobu TAKEDA and Osamu WATANABE of
Nakakubiki-gun, Niigata-ken, Japan, Nakakubiki-gun, Niigata-ken, Japan
and Nakakubiki-gun, Niigata-ken, Japan

Insert Title of Invention ➡ (hereinafter designated as the undersigned) has (have) invented certain new and useful improvements in _____
Polymer, Resist Composition and Patterning Process

for which an application for Letters Patent of the United States of America has been executed by the undersigned (except in the case of a provisional application).

Insert Date of Signing of Application ➡ on December 22, 2003; and

Insert Name of Assignee ➡ WHEREAS, Shin-Etsu Chemical Co., Ltd.

Insert Address of Assignee ➡ of 6-1, Otemachi, 2-chome, Chiyoda-ku, Tokyo, Japan

CHECK BOX IF APPROPRIATE ➡ ☐ its heirs, successors, legal representatives and assigns (hereinafter designated as the Assignee) is desirous of acquiring the entire right, title and interest in and to said invention and in and to any Letters Patent(s) that may be granted therefor in the United States of America and ☐ in any and all foreign countries.

NOW, THEREFORE, in consideration of the sum of Ten Dollars (\$10.00) to the undersigned in hand paid, the receipt of which is hereby acknowledged, and other good and valuable consideration, the undersigned has (have) sold, assigned and transferred, and by these presents does sell, assign and transfer unto said Assignee the full and exclusive right to the said invention in the United States of America, its territories, dependencies and possessions and the entire right, title and interest in and to any and all Letters Patent(s) which may be granted therefor in the United States of America, its territories, dependencies and possessions, and if the box above is designated, in any and all foreign countries;

and to any and all divisions, reissues, continuations, conversions and extensions thereof for the full term or terms for which the same may be granted.

The undersigned agree(s) to execute all papers necessary in connection with this application and any continuing, divisional, conversion or reissue applications thereof and also to execute separate assignments in connection with such applications as the Assignee may deem necessary or expedient.

The undersigned agree(s) to execute all papers necessary in connection with any interference which may be declared concerning this application or continuation, division, conversion or reissue thereof or Letter Patent(s) or reissue patent issued thereon and to cooperate with the Assignee in every way possible in obtaining and producing evidence and proceeding with such interference.

The undersigned agree(s) to execute all papers and documents and to perform any act which may be necessary in connection with claims or provisions of the International Convention for the Protection of Industrial Property or similar agreements.

The undersigned agree(s) to perform all affirmative acts which may be necessary to obtain a grant of a valid United States of America patent(s) or a grant of a valid United States of America and any foreign patent(s) to the Assignee and to vest all rights therein hereby conveyed to said Assignee as fully and entirely as the same would have been held by the undersigned if this Assignment and sale had not been made.

The undersigned hereby authorize(s) and request(s) the Patent and Trademark Office Officials in the United States of America and in any foreign countries to issue any and all Letters Patents resulting from said application or any continuing, divisional conversion or reissue applications thereof to the said Assignee, as Assignee of the entire interest, and hereby covenants that he has (they have) the full right to convey the entire interest herein assigned, and that he has (they have) not executed, and will not execute, any agreement in conflict herewith.

The undersigned hereby grant(s) the law firm of Birch, Stewart, Kolasch & Birch, LLP the power to insert on this Assignment any further identification which may be necessary or desirable in order to comply with the rules of the U.S. Patent and Trademark Office for recordation of this document.

The undersigned hereby covenant(s) that no assignment, sale, agreement or encumbrance has been or will be made or entered into which would conflict with this assignment.

In witness whereof, executed by the undersigned on the date(s) opposite the undersigned name(s).

Date <u>December 22, 2003</u> ,	Name of Inventor <u><i>Jun Hatakeyama</i></u> (signature) <u>Jun HATAKEYAMA</u>
Date <u>December 22, 2003</u> ,	Name of Inventor <u><i>Takanobu Takeda</i></u> (signature) <u>Takanobu TAKEDA</u>
Date <u>December 22, 2003</u> ,	Name of Inventor <u><i>Osamu Watanabe</i></u> (signature) <u>Osamu WATANABE</u>
Date _____,	Name of Inventor _____ (signature)
Date _____,	Name of Inventor _____ (signature)
Date _____,	Name of Inventor _____ (signature)